

Gulf of Maine haddock

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Table R.A.1. Coefficients of variation (CV) at age for Gulf of Maine haddock commercial landings, 1984 to 2007. *Note: CVs can not be determined for landings before 1984 because individual biological samples can not be identified in the database.

Year	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1984	0.23	0.09	0.09	0.11	0.03	0.09	0.12	0.09	0.27	0.53	0.17	0.25		
1985	0.18	0.10	0.16	0.08	0.11	0.05	0.11	0.16	0.18	1.28	0.79			
1986		0.07	0.06	0.05	0.04	0.04	0.08	0.17	0.24					
1987	0.41	0.19	0.07	0.05	0.07	0.05	0.08	0.10	0.19	0.46				
1988		0.34	0.23	0.31	0.46	0.31	0.45	0.55	0.65					
1989	0.79	1.02	0.43	0.41	0.38	0.32	0.93	1.13						
1990	0.85	0.24	1.07	0.50	0.48	0.52	1.04							
1991	0.54	0.26	0.13	0.25	0.23	0.24	0.52	0.85						
1992	0.89	0.19	0.40	0.57	0.73	1.01		1.43						
1993	0.18	0.18	0.19	0.25	0.28	0.49								
1994	0.17	0.10	0.27	0.38	0.31	0.23	0.47	1.09	1.13	0.88				
1995		0.74	0.14	0.44	0.42	0.35	0.44	8.11	0.99	0.61				
1996	0.85	0.26	0.24	0.34	0.31	0.45	0.76	1.06						
1997	0.99	0.12	0.14	0.13	0.26	0.24	0.37	0.35	0.77	1.15				
1998	0.83	0.30	0.14	0.11	0.19	0.36	0.37	0.61	1.24	1.38				
1999		0.28	0.21	0.20	0.23	0.22	0.37	0.55		1.12	0.97	1.43		
2000	0.54	0.24	0.16	0.12	0.11	0.17	0.26	0.52	0.65		0.87	0.70	0.77	
2001	0.45	0.10	0.10	0.16	0.11	0.15	0.22	0.37	0.53	0.92			1.10	
2002		0.44	0.08	0.15	0.13	0.24	0.17	0.21	0.28	0.48	1.36			
2003	0.81	0.19	0.05	0.11	0.14	0.19	0.15	0.18	0.46	0.40	0.75	1.28		
2004		0.68	0.47	0.17	0.04	0.12	0.19	0.26	0.28	0.31	0.46	0.99		
2005	0.73	0.27	0.15	0.10	0.03	0.15	0.17	0.27	0.29	0.27	0.73	1.21		
2006		0.25	0.76	0.16	0.13	0.09	0.04	0.12	0.18	0.30	0.22	0.33	0.55	1.34
2007	1.39	0.59	0.08	0.37	0.14	0.15	0.10	0.05	0.19	0.26	0.52	0.57	0.61	1.36

Table R.A.2. Fleet-specific discards (kg) of Gulf of Maine haddock observed by the Northeast Fisheries Observer Program (NEFOP), 1989 to 2007.

Year	Otter trawl, bottom, large mesh ($\geq 5.5"$) (kg)	Otter trawl, bottom, small mesh (< 5.5") (kg)	Otter trawl, paired- midwater (kg)	Otter trawl, midwater (kg)	Longline, benthic (kg)	Gillnet, sink (kg)	Other (kg)	Percent of total discards by other fleets (%) (kg)
1989	12.7	0.5	0.0	0.0	0.0	16.8	0.9	2.9
1990	0.9	0.0	0.0	0.0	0.0	12.7	4.1	23.2
1991	11.8	0.0	0.0	0.0	2.7	87.5	1.8	1.7
1992	66.2	0.0	0.0	0.0	0.0	54.9	10.0	7.6
1993	70.3	0.0	0.0	0.0	0.0	73.0	21.3	12.9
1994	67.6	0.0	0.0	0.0	0.0	30.4	21.3	17.9
1995	773.2	13.2	0.0	0.0	0.0	27.2	16.8	2.0
1996	319.3	44.0	0.0	0.0	0.0	92.5	6.8	1.5
1997	1214.9	0.0	0.0	0.0	0.0	0.9	1.8	0.1
1998	12.7	0.0	0.0	0.0	0.0	25.4	0.0	0.0
1999	1.4	3.6	0.0	0.0	0.0	31.7	0.0	0.0
2000	161.0	0.0	0.0	0.0	0.0	63.5	0.0	0.0
2001	110.7	112.9	0.0	0.0	0.0	25.4	0.0	0.0
2002	118.4	41.7	0.0	0.0	0.0	83.9	0.0	0.0
2003	441.7	15.0	0.0	0.0	68.9	157.8	0.0	0.0
2004	343.8	166.4	154.2	119.3	5.4	268.0	0.9	0.1
2005	799.1	57.6	497.9	110.2	542.4	375.5	0.5	0.0
2006	868.9	24.0	0.0	2.7	345.1	70.7	9.5	0.7
2007	375.0	25.4	127.4	0.0	318.8	528.8	4.1	0.3
Annual average	303.7	26.5	41.0	12.2	67.5	106.7	5.3	0.9

Table R.A.3. Discard reasons by year described as a percent occurrence from Northeast Fisheries Observer Program (NEFOP), 1989 to 2007.

Year	Discard reason by percent of total weight				Total weight of discards with discard reason available (lb)	Count of observed hauls with discard reasons available
	Other / unknown	Quota filled / retention prohibited	Upgraded	Poor quality		
1989	49.3	0.0	0.0	50.7	0.0	69
1990	66.7	0.0	0.0	33.3	0.0	30
1991	71.1	0.0	0.0	28.9	0.0	225
1992	79.8	0.0	0.0	20.2	0.0	297
1993	72.2	13.6	0.0	14.2	0.0	316
1994	47.8	42.7	0.0	0.0	9.5	216
1995	22.5	46.9	0.0	0.5	30.1	1,794
1996	1.0	29.6	13.1	5.6	50.7	1,095
1997	4.8	34.5	0.0	50.5	10.2	4,173
1998	44.2	0.0	0.0	4.4	51.4	91
1999	9.9	0.0	0.0	76.5	13.6	81
2000	0.2	0.0	0.0	22.6	77.3	532
2001	2.6	0.0	0.0	3.9	93.5	696
2002	4.9	0.0	0.0	16.0	79.1	614
2003	1.9	0.0	0.0	7.7	90.3	1,544
2004	48.6	0.0	0.0	9.0	42.5	2,876
2005	24.8	0.6	0.0	13.3	61.3	5,178
2006	0.9	0.0	0.0	2.7	96.4	2,854
2007	12.2	0.0	0.0	34.5	53.2	3,006
						160

Table R.A.4. Gulf of Maine haddock minimum size limits for commercial and recreational landings, 1977 to 2008. Prior to 1977 there were no federal minimum size limits for either fishery. Values in italics are assumed pending clarification of regulations.

Year	Commercial minimum size limit (total length, inches)	Recreational minimum size limit (total length, inches)	Management action
1977	16	15	Groundfish Fishery Management Plan
1978	16	15	
1979	16	15	
1980	16	15	
1981	16	15	
1982	16	15	
1983	17	15	Large-mesh multispecies Fishery Management Plan
1984	17	15	
1985	17	15	
1986	17	15	
1987	19	17	Amendment 1
1988	19	17	
1989	19	19	
1990	19	19	
1991	19	19	
1992	19	19	
1993	19	19	
1994	19	19	Amendment 5
1995	19	19	
1996	19	19	
1997	19	19	
1998	19	19	
1999	19	19	
2000	19	19	
2001	19	19	
2002	19	23	Framework 33
2003	19	21	Framework 22
2004	19	19	Amendment 13
2005	19	19	
2006	19	19	
2007	18	19	Emergency action (August 10, 2007 through August 10, 2008)
2008	18	19	

Table R.A.5. Vessel and door types used in the Northeast Fisheries Science Center's spring and autumn bottom trawl surveys where Gulf of Maine haddock were caught and the types of conversion factors applied to the annual indices, 1963 – 2008. Coefficients of 0.82 (Delaware II) and 1.49 (BMV trawl door) were applied to abundance indices and 0.79 (Delaware II) and 1.51 (BMV trawl door) were applied to biomass indices.

Year	Door	Spring survey vessel	Spring conversion factor	Autumn survey vessel	Autumn conversion factor
1963	BMV			Albatross IV	door
1964	BMV			Albatross IV	door
1965	BMV			Albatross IV	door
1966	BMV			Albatross IV	door
1967	BMV			Albatross IV	door
1968	BMV	Albatross IV	door	Albatross IV	door
1969	BMV	Albatross IV	door	Albatross IV	door
1970	BMV	Albatross IV	door	Albatross IV	door
1971	BMV	Albatross IV	door	Albatross IV	door
1972	BMV	Albatross IV	door	Albatross IV	door
1973	BMV	Albatross IV	door	Albatross IV	door
1974	BMV	Albatross IV	door	Albatross IV	door
1975	BMV	Albatross IV	door	Albatross IV	door
1976	BMV	Albatross IV	door	Albatross IV	door
1977	BMV	Albatross IV	door	Delaware II	door
1978	BMV	Albatross IV	door	Delaware II	door
1979	BMV	Albatross IV/Delaware II	door, vessel	Albatross IV/Delaware II	door, vessel
1980	BMV	Delaware II	door, vessel	Delaware II	door
1981	BMV	Delaware II	door, vessel	Albatross IV/Delaware II	door, vessel
1982	BMV	Albatross IV	door	Albatross IV	door
1983	BMV	Albatross IV	door	Albatross IV	door
1984	BMV	Albatross IV	door	Albatross IV	door
1985	Polyvalent	Albatross IV		Albatross IV	
1986	Polyvalent	Delaware II	vessel	Albatross IV	
1987	Polyvalent	Albatross IV		Albatross IV	
1988	Polyvalent	Delaware II	vessel	Albatross IV	
1989	Polyvalent	Delaware II	vessel	Delaware II	vessel
1990	Polyvalent	Delaware II	vessel	Delaware II	vessel
1991	Polyvalent	Albatross IV		Delaware II	vessel
1992	Polyvalent	Albatross IV		Albatross IV	
1993	Polyvalent	Delaware II	vessel	Delaware II	vessel
1994	Polyvalent	Albatross IV		Albatross IV	
1995	Polyvalent	Albatross IV		Albatross IV	
1996	Polyvalent	Albatross IV		Albatross IV	
1997	Polyvalent	Albatross IV		Albatross IV	
1998	Polyvalent	Albatross IV		Albatross IV	
1999	Polyvalent	Albatross IV		Albatross IV	
2000	Polyvalent	Albatross IV		Albatross IV	
2001	Polyvalent	Albatross IV		Albatross IV	
2002	Polyvalent	Delaware II	vessel	Albatross IV	
2003	Polyvalent	Albatross IV		Albatross IV	
2004	Polyvalent	Albatross IV		Albatross IV	
2005	Polyvalent	Albatross IV		Albatross IV	
2006	Polyvalent	Albatross IV		Albatross IV	
2007	Polyvalent	Albatross IV		Albatross IV	
2008	Polyvalent	Albatross IV		N/A	

Table R.A.6. Summary of the number of individual length and age measurements taken during the Northeast Fisheries Science Center spring and autumn bottom trawl surveys, 1963 – 2008.

Year	Lengths		Ages	
	Spring	Autumn	Spring	Autumn
1963		2347		320
1964		412		140
1965		609		142
1966		356		140
1967		316		162
1968	189	260	108	232
1969	134	161	94	148
1970	36	74	36	69
1971	39	72	38	50
1972	37	53	34	51
1973	50	142	44	112
1974	61	114	26	58
1975	280	365	132	175
1976	919	363	154	164
1977	498	660	150	181
1978	68	887	29	78
1979	219	603	19	145
1980	105	331	59	117
1981	199	151	115	28
1982	106	101	76	64
1983	159	102	64	99
1984	35	59	34	59
1985	92	194	65	137
1986	27	29	26	29
1987	5	35	5	27
1988	10	13	9	12
1989	10	22	10	21
1990	2	9	1	9
1991	4	9	4	6
1992	9	11	9	8
1993	25	64	19	34
1994	24	16	20	10
1995	31	55	21	33
1996	10	91	10	66
1997	98	115	60	74
1998	11	225	11	90
1999	278	517	77	216
2000	207	809	83	157
2001	209	468	72	184
2002	333	151	119	98
2003	236	233	118	130
2004	56	312	41	113
2005	49	197	33	117
2006	232	288	95	167
2007	48	251	38	125
2008	126		57	

Figures

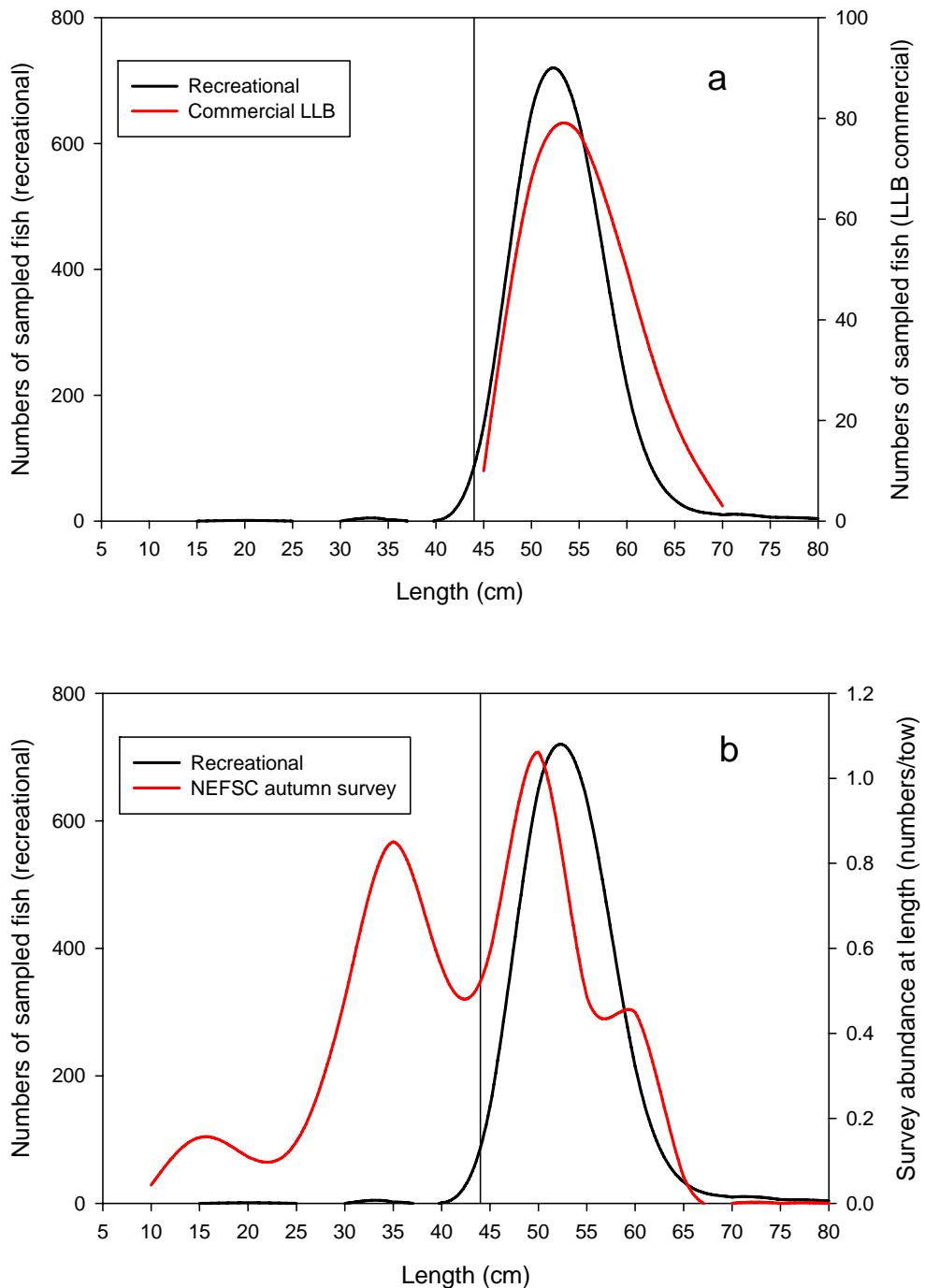


Figure R.A.1. Selectivity of the recreational fishery relative to the commercial longline fishery (a) and Northeast Fisheries Science Center bottom trawl survey (b). Solid vertical lines indicate minimum legal size for recreational fishery. Data shown are from 2005.

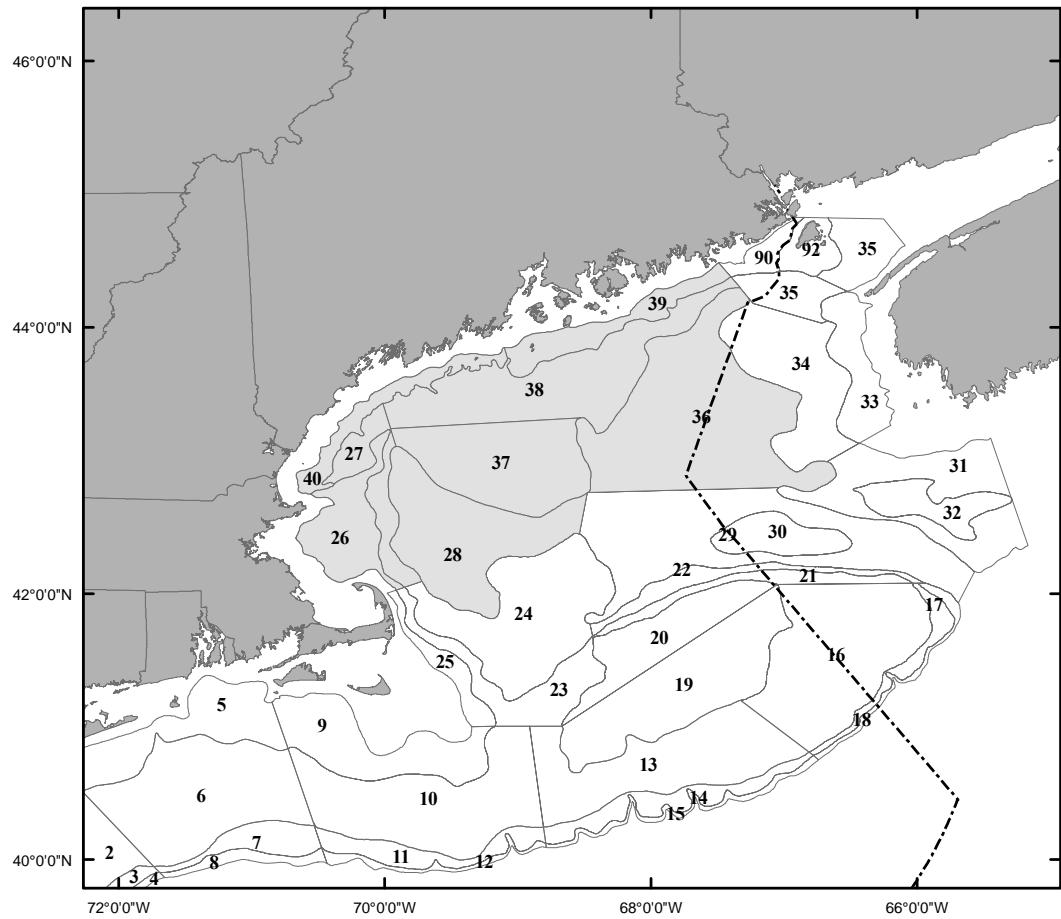


Figure R.A.2. Northeast Fisheries Science Center (NEFSC) bottom trawl survey strata used to calculate the Gulf of Maine survey indices. Dashed line represents the United States Exclusive Economic Zone.

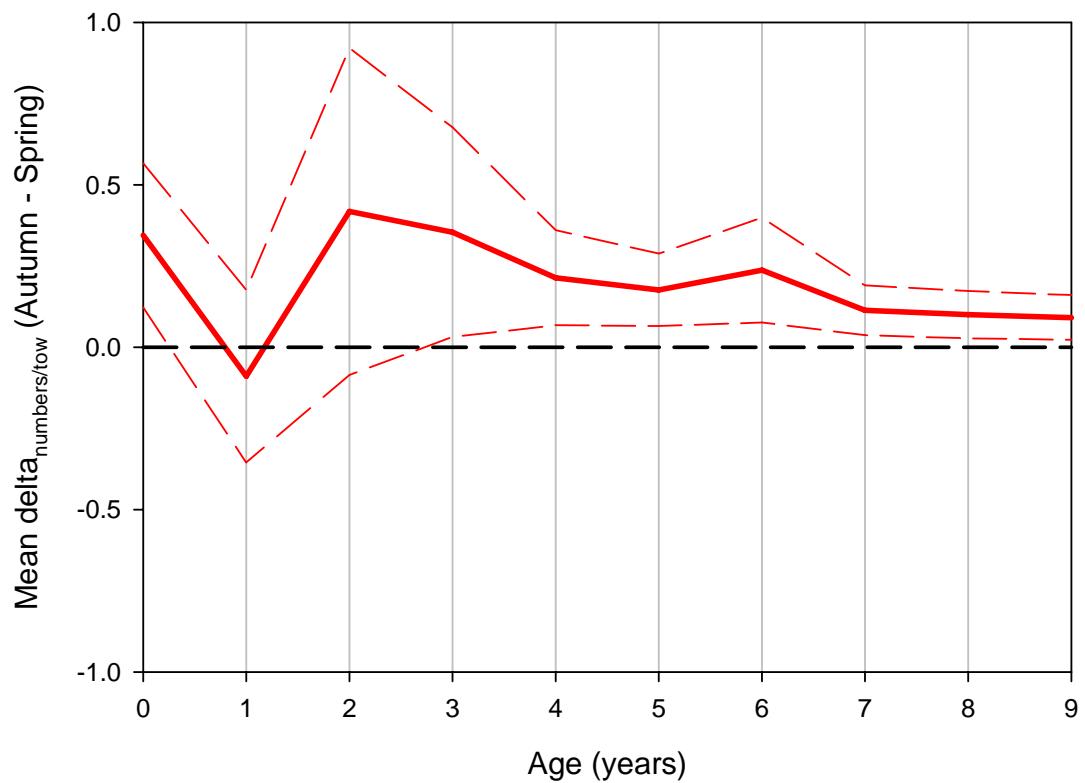


Figure R.A.3. Mean differences in survey numbers/tow between the NEFSC autumn and spring bottom trawl surveys by age. Dashed red lines represent 95 % confidence intervals.

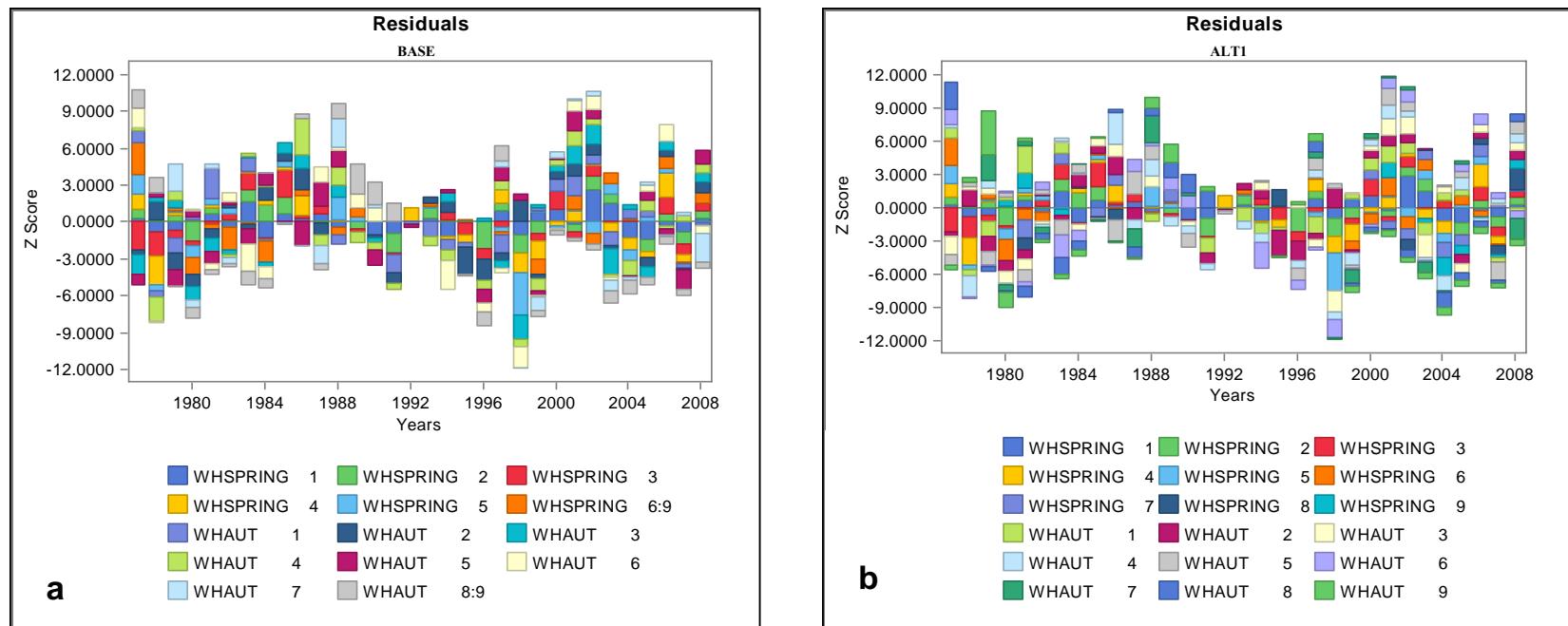


Figure R.A.4. Combined survey residuals at age for the BASE virtual population analysis (VPA) configuration (a) and ALT1 VPA configuration (b).

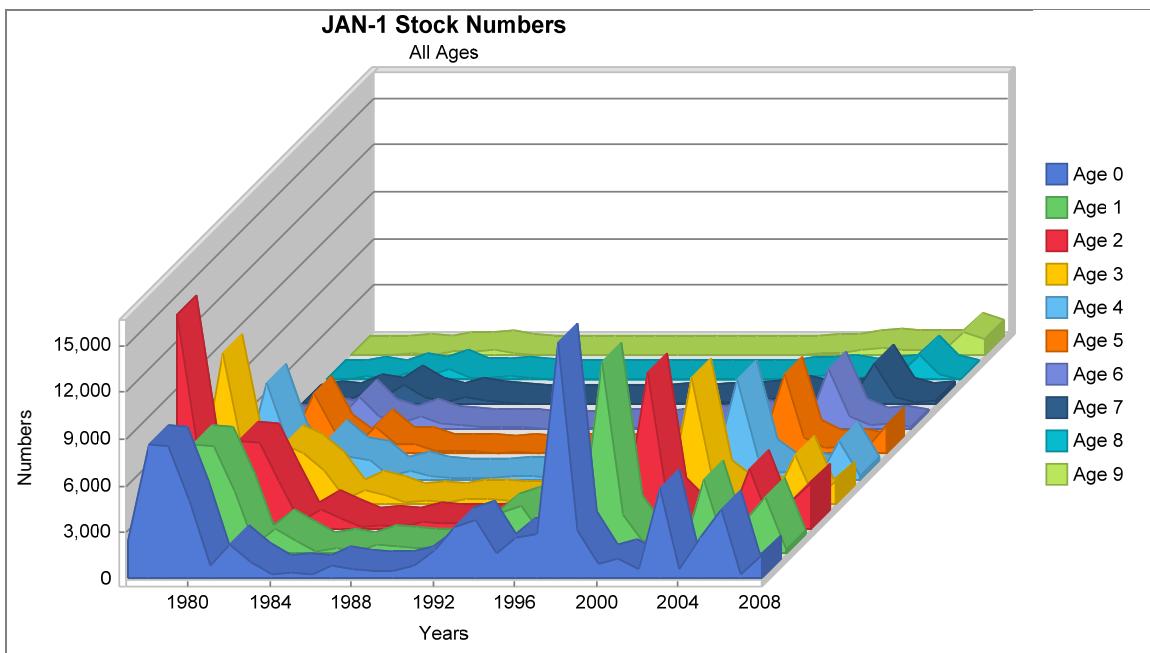


Figure R.A.5. Virtual Population Analysis (VPA) of the Gulf of Maine haddock January 1 stock size at age.

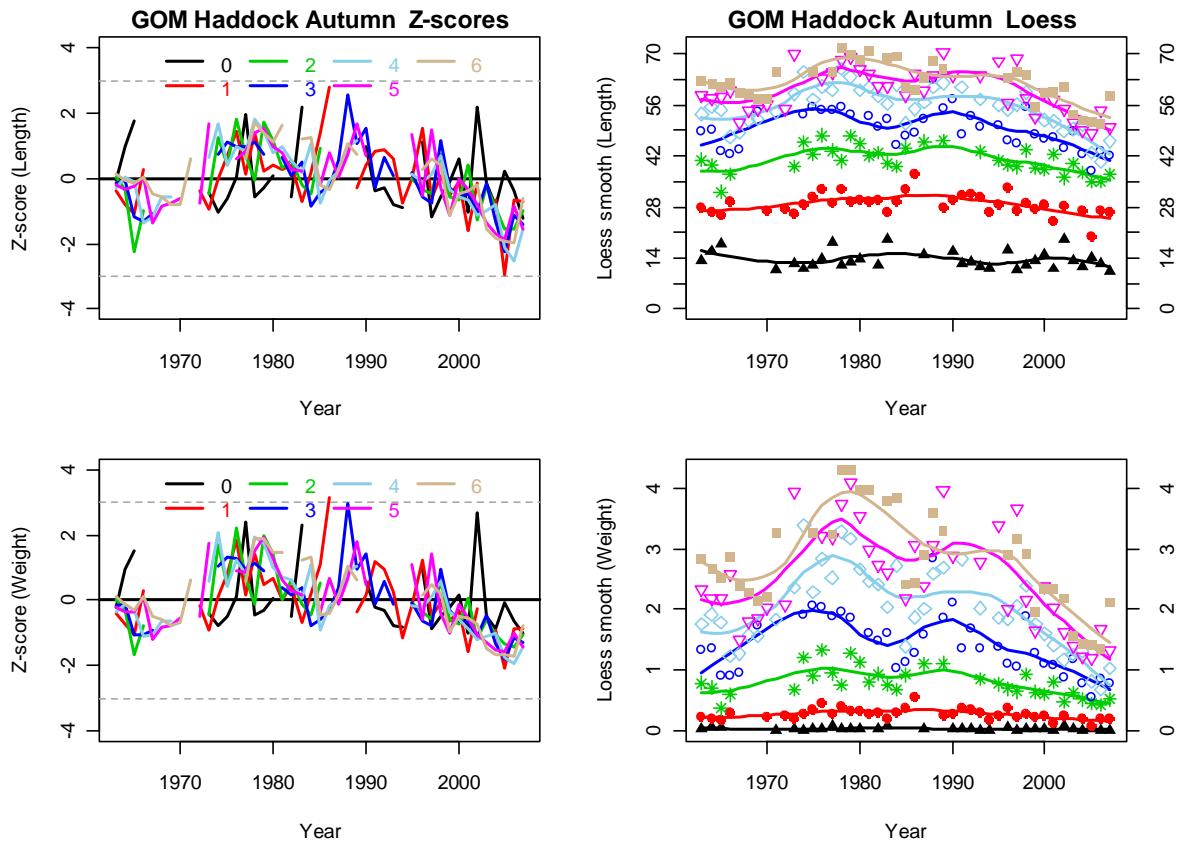


Figure R.A.6. Mean size at age (length and weight) of age 0 to 6 Gulf of Maine haddock in the Northeast Fisheries Science Center's autumn bottom trawl survey, 1962 to 2007 (from O'Brien et al, 2008).

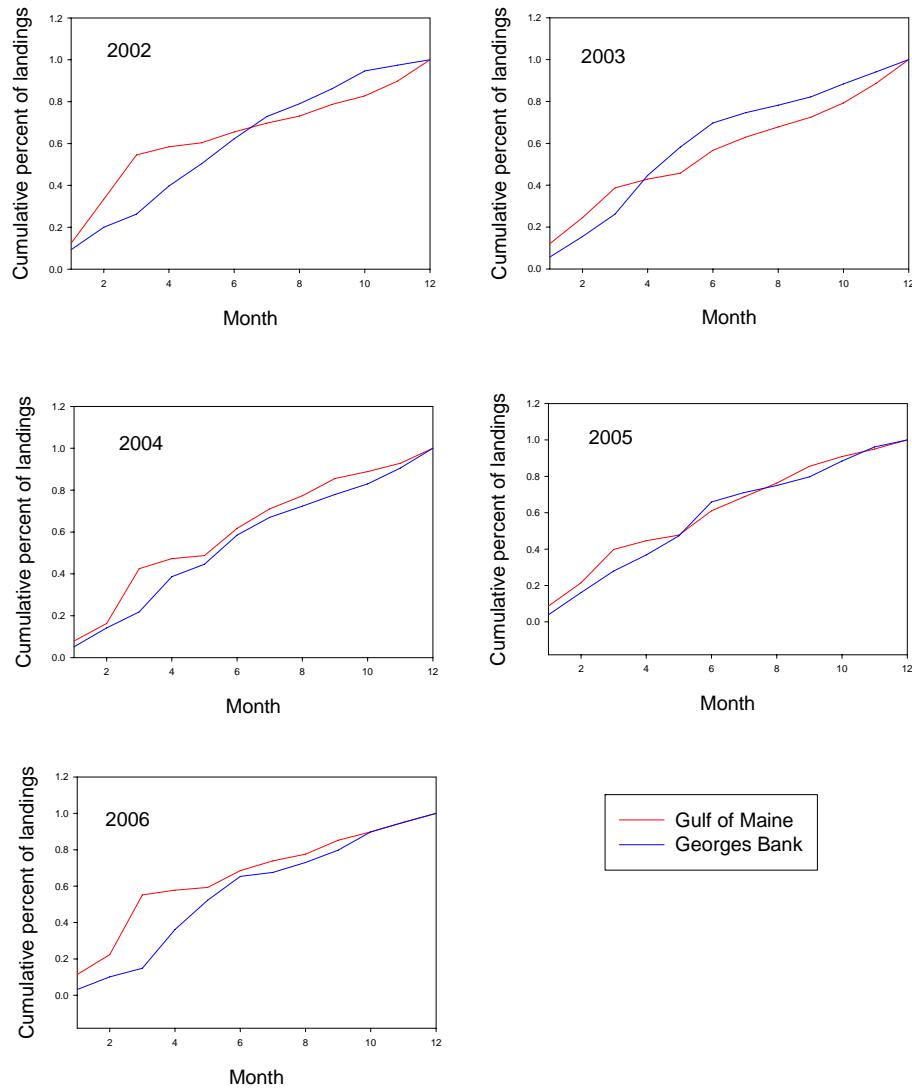


Figure R.A.7. Cumulative percent of commercial landings of haddock by month for the Gulf of Maine and Georges Bank stocks between 2002 and 2006.

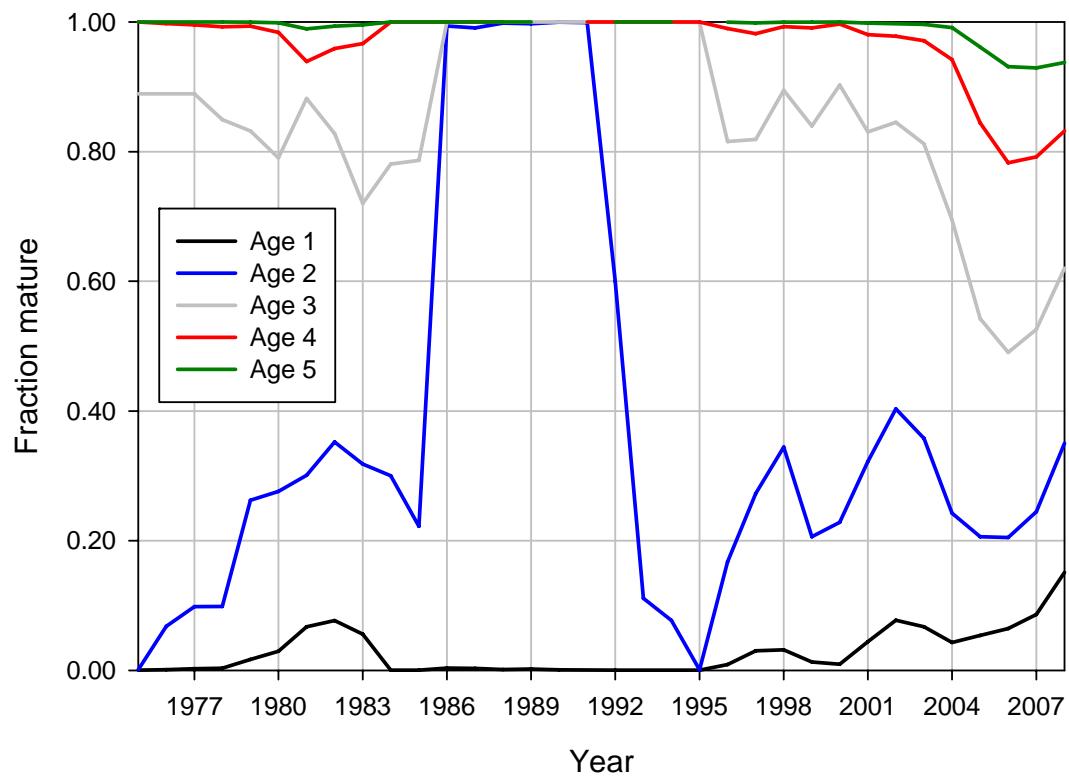


Figure R.A.8. Proportion mature at age of female Gulf of Maine haddock using a 3-year moving window for ages 1-5 (upper panel). Data are from the Northeast Fisheries Science Center spring bottom trawl survey, 1975 to 2008.

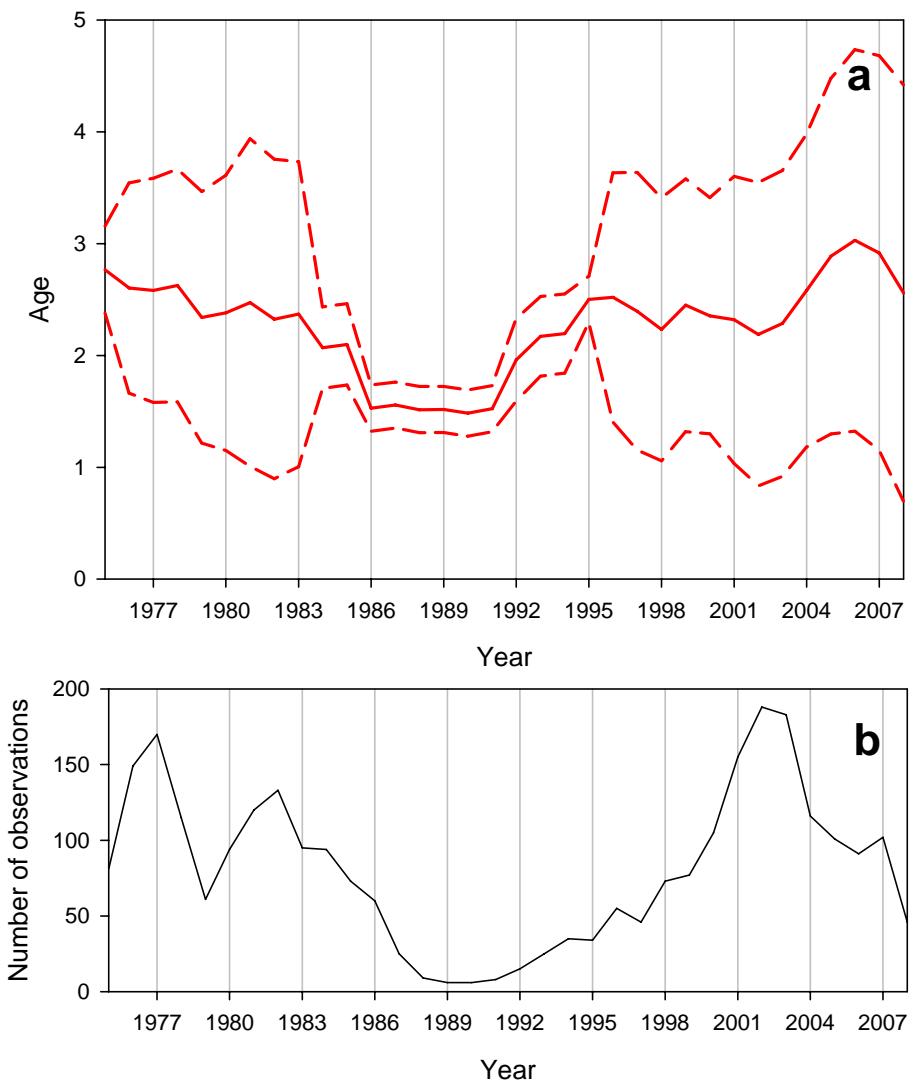


Figure R.A.9. Median age at maturity (A_{50}) of females a) with 95% confidence intervals, and number of samples in the combined 3-year moving average (b). Data are from the Northeast Fisheries Science Center spring bottom trawl survey 1975 to 2008.

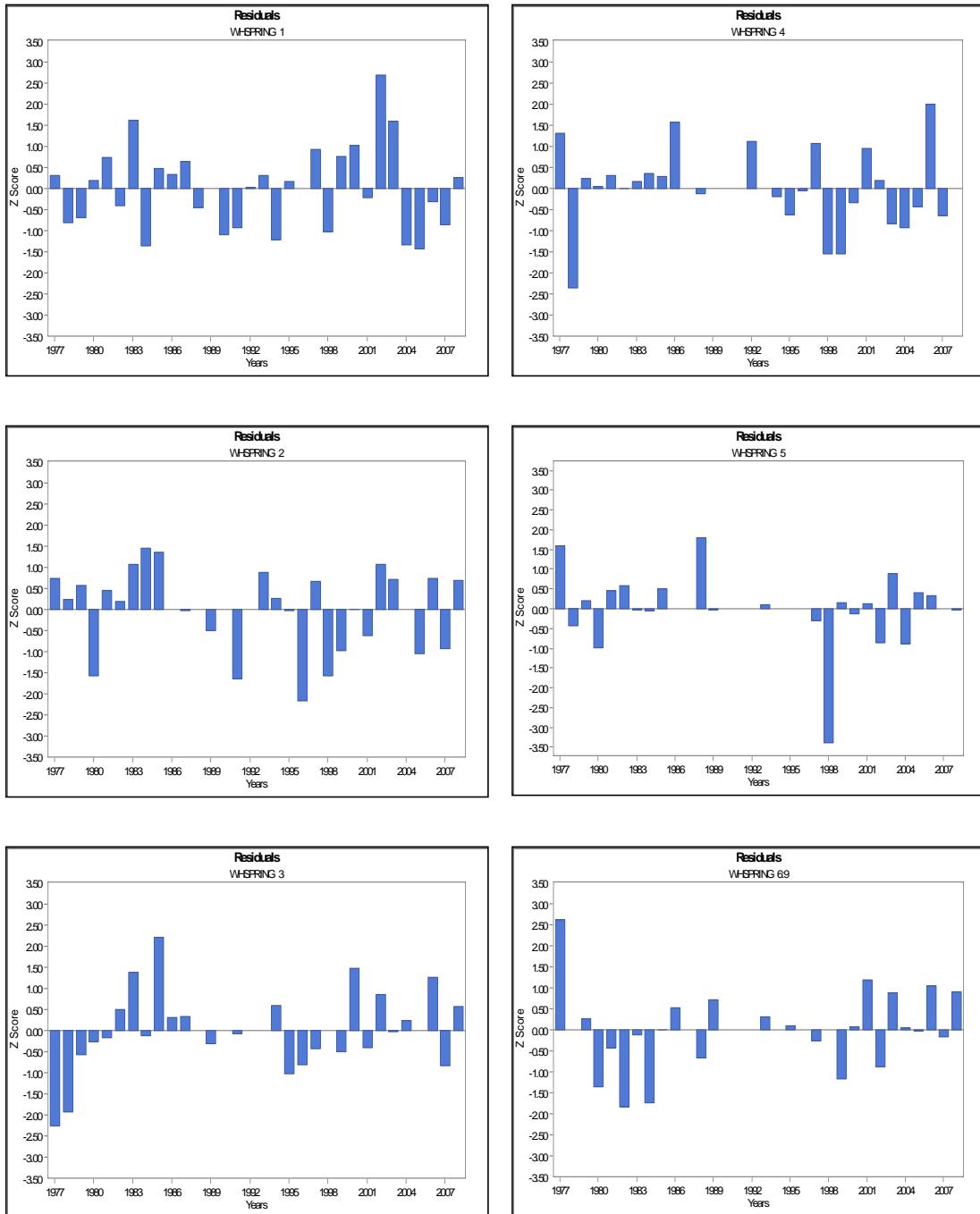


Figure R.A.10. Standardized residuals for the age 1 through 6:9⁺ spring survey indices used to tune the BASE virtual population analysis run for Gulf of Maine haddock.

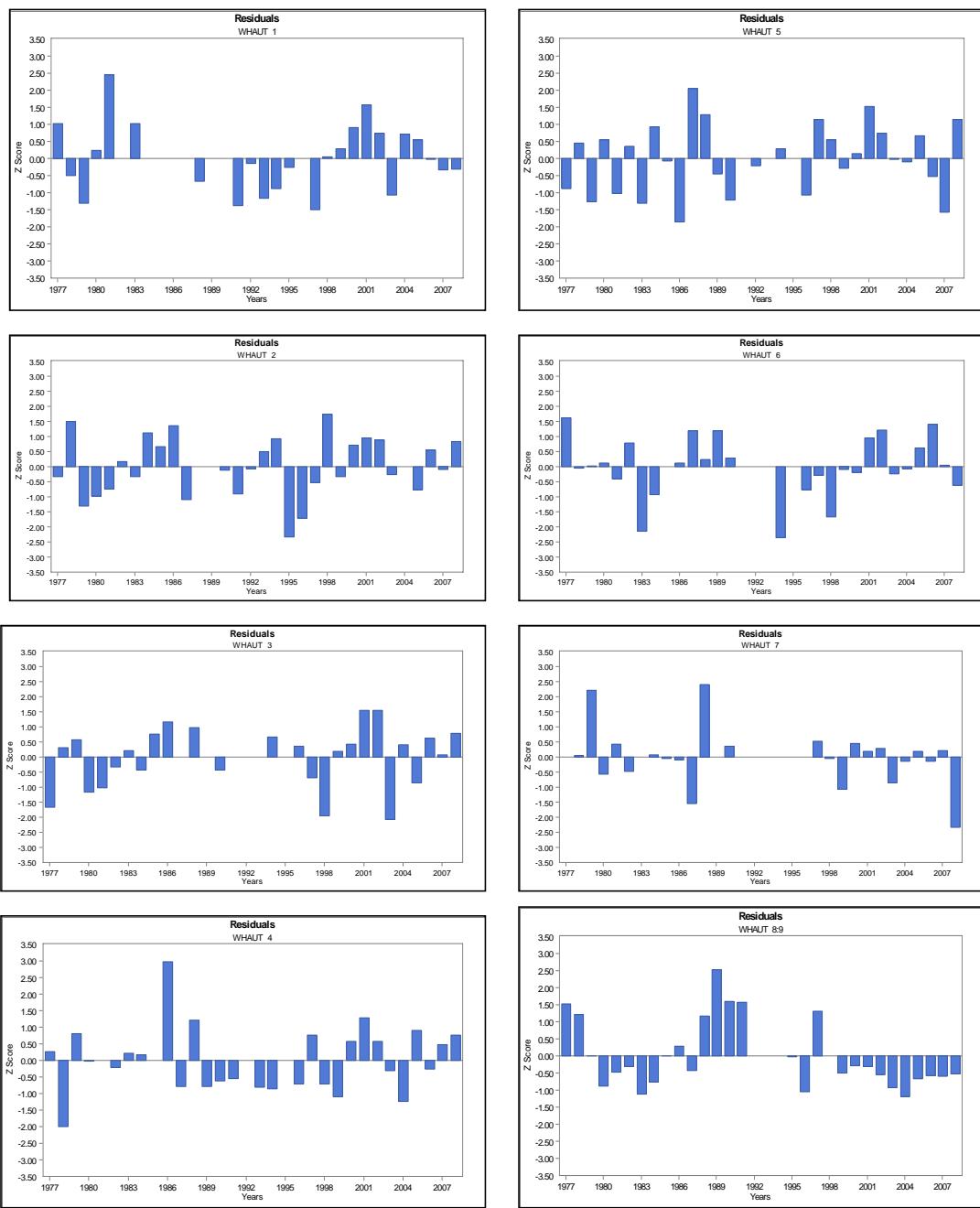


Figure R.A.11. Standardized residuals for the age 1 through 8:9⁺ autumn survey indices used to tune the BASE virtual population analysis run for Gulf of Maine haddock.

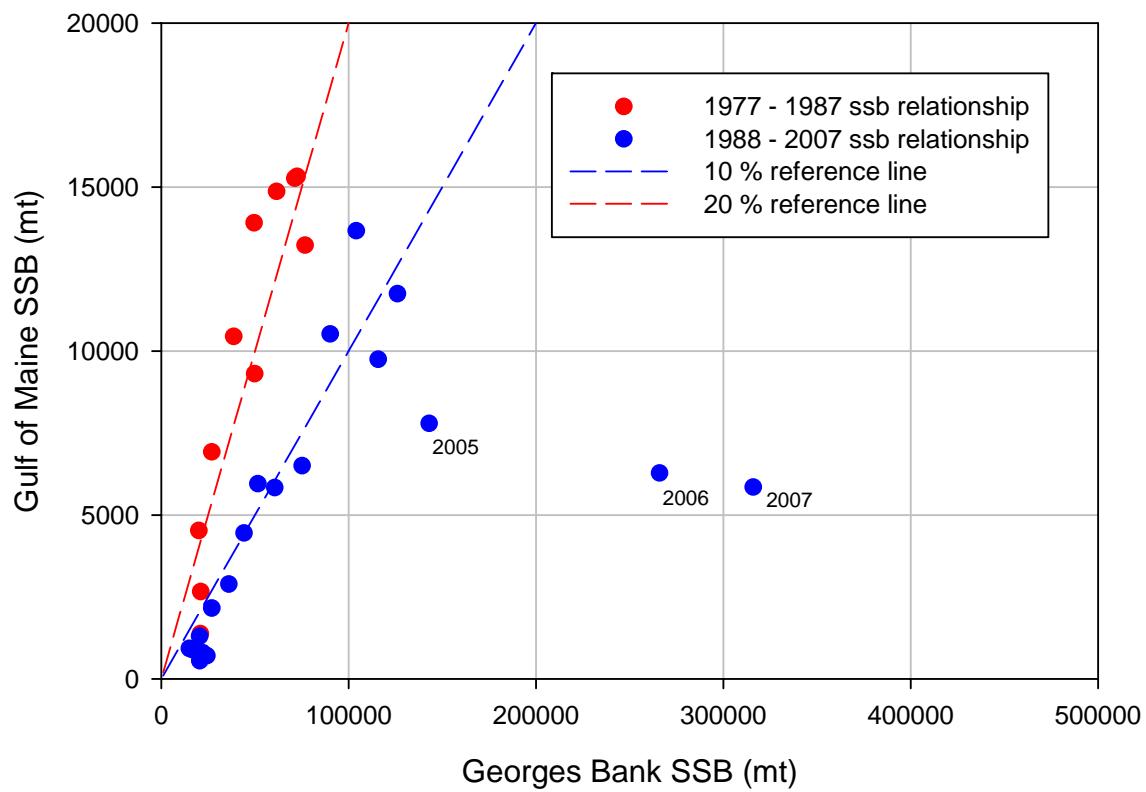


Figure R.A.12. Comparison of Gulf of Maine haddock spawning stock biomass to Georges Bank haddock spawning stock biomass in two periods; 1977 to 1988 and 1989 to 2006.